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IN CONDITIONED RESPONSES IN MONKEYS

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EXPERIMENTAL ANALYSIS OF THE ROLE OF THE
ORIGINAL STIMULUS IN CONDITIONED
RESPONSES IN MONKEYS†*

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PURPOSE

The purpose of this paper is to describe an analysis of the conditioned response through a study of the role of the original¹ stimulus. The following two problems were investigated: (1) the effect of inactivating the original stimulus by reconditioning and negative adaptation, and (2) the effect of functional reversal of substitute and original stimuli. The methods used and the results obtained in each problem are reported separately.

A: THE EFFECT OF INACTIVATION OF THE ORIGINAL
STIMULUS ON CONDITIONED RESPONSES IN
MONKEYS.

1. *Animals, apparatus, method*

Four monkeys were used as subjects in this investigation: 3 *Macacus rhesus* and 1 *Macacus nemistrinus*. The last-named animal was mature. The 3 rhesus were young, judged to be 3-4 years of age. All the monkeys were housed and tested in the University of Wisconsin Primate Laboratory.

Three different learning situations were used and a brief description of each follows.

Situation I. In this situation the SS was the sound of a bell presented for 2 seconds and followed immediately by the OS². The OS was the sudden unrolling, in the direction of the animal, of a paper roll. (The stimulus instrument was a party-favor, one of a kind which is unrolled by blowing into a paper or wooden mouthpiece.

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¹ Guthrie's (2) terminology of substitute and original stimulus is used throughout this paper rather than Pavlov's (5) terminology of conditioned and unconditioned stimulus. Substitute stimulus is abbreviated as SS and original stimulus as OS.

² The SS (sound of bell) called out only slight investigatory responses before training. The OS (blowout) caused a violent fear response.

In a novelty catalog it is named "snake blowout" and hereafter it is designated simply as a "blow-out").

Two of the rhesus served as subjects for this test. These animals were trained to submit to being restrained in a chair placed in the center of a table which was 4 feet square [see Harlow and Settlage (3) for methods]. The experimenter sat behind a panel which the animal faced, and observed the monkey through a one-way visual screen while controlling the presentation of stimuli.

Situation II. The OS in this situation was the impact of a small bolt fired at the animal from a toy pop-gun.³ The SS was the sight of an experimenter raising this gun from a table to firing position. After this association had been established, a new conditioned response was formed using the sound of a bell as a new SS and the sight of the gun as a new OS.⁴

One *Macacus rhesus* and the *Macacus nemistrinus* were tested in Situation II. During the experimental period the animals were confined in a wire cage whose dimensions were 30x30x18 inches. Two experimenters cooperated in conducting these tests. One of them served as a part of the stimulus situation. He handled the gun and while working was in the view of the monkey. The second experimenter operated the bell switch and kept the records; he was hidden from the monkey's view.

2. Negative adaptation of the original stimuli

After learning had been effected in both of the situations described above, negative adaptation of the original stimuli was begun, i. e., the response to the OS was eliminated by repetition of the OS and by reconditioning.

Situation I—negative adaptation of the OS: The blowout used as the OS of situation I was rendered non-effective as a fear stimulus by repeatedly unrolling or blowing it slowly and having food on or in it during the blowing process. The fear-evoking qualities of the

³ The impact of the bolt was slight and caused the animal little distress. Indeed, this "unconditioned response" lost its affective quality and underwent marked decrement with repetition. Even after this decrement occurred, the response to the SS remained vigorous. There was no evidence of spontaneous waning of the response. If anything, it became stronger with *unreinforced* repetition of the SS. It should also be noted that after conditioning, the strength of the response to the SS was greater than the previous response to the OS.

⁴ In Pavlovian terminology this would be a "2nd order conditioned response." Since the "1st order conditional stimulus", however, failed to extinguish, this new response did not show the characteristics attributed by Pavlov to "2nd order conditional responses."

blowout were abolished by this method with unexpected ease; at the end of a single hour no fear responses were aroused even when it was blown directly into the face of one monkey, and the second animal showed no fear response by the end of the experimental period of the second day. When the blowout was in its usual position, the monkeys disregarded it or were even attracted to it. This process of negative adaptation and reconditioning was continued for two more experimental periods on successive days, and at the end of an additional 3-day period of no training, testing revealed that there had been little if any spontaneous return of fear responses to the blowout.

Situation II—negative adaptation of the OS: The fear stimulus of the second situation was the sight of the gun, (the contact stimulus of the bolt had already undergone auto-extinction). It was negatively adapted and reconditioned in a manner similar to that outlined for situation I. Pieces of food were placed in the muzzle of the gun and offered to the monkey. Later these were attached to the gun by a string, and fired at the animal. The sight of the gun rapidly came to be a stimulus causing approach responses, even when food was absent.

3. Results of negative adaptation of the original stimulus

After the OS had been negatively adapted in both situations, the unreinforced SS was presented for 5 consecutive trials. The results obtained are summarized below:

Situation I.

Subject 1: The SS (bell), on the first trial called forth a response (rhesus) which the experimenter could not differentiate from that which had been called out before negative adaptation of the OS. The conditioned response was elicited as rapidly as before and showed no loss of intensity nor any observable change in form. Four succeeding trials gave the same results.

Subject 2: Same as above.

(rhesus)

Situation II.

Subject 3: The SS (bell) elicited a response identical in strength (rhesus) and pattern with that called out by it before negative adaptation of the OS (sight of gun). The 4 succeeding trials gave the same results.

Subject 4: Same as above.

(nemis-
trinus)

B: FUNCTIONAL REVERSAL OF SUBSTITUTE AND ORIGINAL STIMULI IN MONKEYS.

1. *Animals, apparatus, method*

The subjects and apparatus were the same as those used in Part A of this experiment. The procedure was simply to present the blowout (OS of situation I) or the sight of the gun (OS of situation II) and thereupon to ring the bell (which had been the SS for both situations). The bell followed the blowout by about 2 seconds and the gun by about 3 seconds. By this procedure the attempt was made in both situations to associate the stimulus which had first been the OS with the stimulus which had been the SS.

2. *Results of attempted functional reversal of stimuli*

Situation I

Subject 1: Functionally reversed conditioning was readily obtained (rhesus) by presentation of the SS (blowout) with the OS (bell). The conditioning was clearly apparent by the 5th trial and strongly established by the 10th. The newly conditioned response was even more violent than the response previously conditioned. Presentation of the blowout alone, without "reinforcement" by the bell, for 20 trials a day for 5 days, caused no appreciable experimental extinction. An attempt to eliminate the response to the blowout by following it with proffered food was unavailing. Throughout the entire procedure, the strength of the response to the blowout appeared, if anything, to increase in violence. An attempt to eliminate the response to the sound of the bell was no more successful. The animal was now less amenable to re-education than it had been originally.

Subject 2: Functionally reversed conditioning was readily obtained (rhesus) and firmly established within 10 trials. The early responses were extremely violent but showed definite "experimental extinction" after 20 unreenforced trials had been given on each of 2 successive days. Further efforts to "experimentally extinguish" the SS were then discontinued and an attempt made to reverse the conditioning process. The conditioned response SS (blowout)—OS (bell) was "reinforced" for 5 trials and the attempt made to eliminate the response to the bell by presentation of the bell alone and by following the sound of the bell with proffered food. Reeduca-

tion was attempted an hour a day for 3 days with partial success. At the end of this time the response to the bell was weak and inconstant, although not completely eliminated. Unfortunately, the response to the blowout (which had been presented only 6 times for test purposes) had also diminished in strength, although to a lesser degree than the response to the bell. The bell was then presented and followed by the blowout in an attempt to obtain reversed conditioning. At the end of 10 paired presentations, the response to the bell had increased somewhat in strength. The data, however, did not provide convincing evidence for re-reversed conditioning.

Situation II

- Subject 3: Functionally reversed conditioning was effected by paired presentation of SS (sight of gun) and OS (bell) for 5 trials, and was strongly established by the 20th trial. The new response was of extreme violence and did not abate following 40 daily "unreinforced" trials given on 5 successive days. The attempt to eliminate the response to the sound of the bell by following this with proffered food was likewise unsuccessful. By the end of this time the monkey had become highly emotional and unstable. Because of the unmanageability of the animal, the experiment was discontinued.
- Subject 4: Functionally reversed conditioning was readily effected in the case of this monkey by presentation of the SS (sight of gun) followed in 3 seconds by the OS (bell). The 3rd presentation of the SS was followed by typical grimacing and retreating responses. On trials 5-17 an interesting, typical form of behavior occurred. When the SS was presented, the monkey would grimace, draw back, and then reach toward or come forward to the gun to investigate for food. Its entire behavior suggested "conflict". The forward orientation was accompanied by constant grimacing, head movements, and shivering, and the monkey gave every evidence of fearfully anticipating the sound of the bell and of wavering between "retreat" and "approach". During a half dozen trials the bell "caught" the animal reaching toward the gun. In all cases the monkey withdrew precipitously to the back of the cage, screaming in fear when the bell was sounded. From the 18-200th trial this behavior never reappeared and the sight of the gun

was never again "reenforced" by the sound of the bell. The experimenter did not observe any noticeable "experimental extinction" during this time. Many of the fear responses obtained were of extreme violence. At times, however, the animal showed the frozen "cataleptic" stupor not uncommonly seen in terrified macaques. An attempt to eliminate the response to the bell was also unavailing.

DISCUSSION

Certain of the data obtained in these experiments are not in keeping with the properties commonly attributed to conditioned reflexes. Most striking of all is the *extreme stability of these conditioned responses* and the great difficulty encountered in extinguishing the response to the SS. Thus in situation II the SS (sight of gun) continued to call forth a response after the response to the OS (impact of bolt) had spontaneously adapted out. Furthermore in both situations I and II the SS continued to be effective after deliberate inactivation of the OS by reconditioning and negative adaptation. The fact that functional reversal of the OS and SS was possible, indicates the extreme stability of the SS. Furthermore it should be noted that even after 200 or more unreenforced presentations the SS might continue to elicit a response of *as great or greater violence* than had been the case before "experimental extinction" was attempted. The writer believes that this is a function of the *kind of learning* involved. In cases where the learned modifications are forced or impressed on a subject (and this is probably true to the greatest degree in emotional situations) "experimental extinction" does not readily occur. In human subjects, some children's fears and some adult phobias (the cases of children's fears reported by Jones (4) and the phobias described by Bagby (1) may be cited as specific instances) partake very much of the characteristics of forced learning as observed in these experiments.

Functional reversal of SS and OS was obtained in both situations I and II. The fact that such a phenomenon can be obtained under any circumstances emphasizes the importance of the past history of a particular stimulus as a partial determiner of the role which it will play. For this reason Guthrie's (2) classification of substitute and original stimuli would appear to be more appropriate than Pavlov's (5) classification of conditioned and unconditioned stimuli, since Pavlov used unconditioned to mean inborn and conditioned to mean acquired.

SUMMARY AND CONCLUSIONS

1. Inactivation of the OS by negative adaptation and reconditioning did not destroy or weaken the response to the SS in two situations.
2. Functional reversal of substitute and original stimuli was brought about in two different situations using 4 rhesus monkeys as subjects.
3. In one case a second functional reversal was attempted but the results were not precise enough to permit any conclusion to be derived.
4. Failure consistently to obtain experimental extinction or negative adaptation in the two situations is interpreted as a function of the kind of learning involved.

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